

REMARKS

1. *Status of the Application.* Claims 1-21 are pending in the application. Claim 19 is amended herein; no new matter is added by way of this amendment. The following summarizes the substance of the Office Action:

- claims 10, 11, 14, and 20 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,090,933 to Kayyem et al. ("*Kayyem*");
- claims 19 and 20 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,060,327 to Keen ("*Keen*");
- claims 20 and 21 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,589,692 to Reed ("*Reed*");
- claims 1-4, 7-14, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Keen* in view of *Kayyem*;
- claims 15 and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Keen* in view of *Kayyem* "further in view of the admitted prior art; and
- claims 5, 6, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Reed in view of Keen and Kayyem.

As discussed below, the Assignee respectfully submits that the Office Action critically mischaracterizes the prior art cited in support of the rejections, and the Assignee respectfully requests reconsideration and withdrawal of the rejections in view of the foregoing amendments and ensuing remarks.

2. *The Section 102 Rejections.* Claims 10, 11, 14 and 20 were rejected under § 102 as being unpatentable over *Kayyem*. According to the Office Action, and as its title states, *Kayyem* is directed to "methods of attaching conductive oligomers to electrodes." The Office Action likens the conductive oligomers of *Kayyem* to the thiol-terminated "molecular devices" disclosed in the present application, and notes that the oligomers of *Kayyem* are attached to an electrode "which may be a metal such as gold." Further, the Office Action likens the *Kayyem* "linker" used to attach the oligomer to the electrode to the "metal bonding terminus protected by a protective group." Finally, the Office Action suggests that exposure of the *Kayyem*

oligomer to a solution containing ammonium hydroxide removes the protective group, as disclosed and claimed in the instant application.

Following this analysis, the Office Action concludes by stating "[t]hus, Kayyem et al. disclose the remaining steps recited in instant claims 10 and 11." Applicant respectfully takes issue with this conclusory statement, inasmuch as it appears to wholly ignore other claimed steps. In particular, what *Kayyem* does not appear to either teach or suggest is any step of "activating the metal-bonding 1 terminii of the de-protected molecular device molecules." Instead, the Office Action states only that that in *Kayyem*, removal of the protective group "allowed [the oligomer] to bind to the gold" (emphasis added). That is, *Kayyem* does not teach or suggest techniques for electrochemical assembly of molecular monolayers.

In the present application, "activation" of the metal-bonding terminus is accomplished through "application of a desired chemical or electrochemical stimulus." See, Specification, page 5, lines 7-8. In most preferred embodiments, the activation is achieved through application of a voltage to selected substrates. See, Specification, page 5, line 26 through page 7, line 27. The step of "activation" is an important feature of the invention, inasmuch as it makes it possible to "apply different molecular device species sequentially without affective previously applied layers." Specification, page 7, lines 15-16. It is submitted that such capability is not realized through the teachings or suggestions of *Kayyem*.

As to the significance of *Kayyem*'s failure to teach or suggest these important features of the invention, it is to be further noted that the step of "activation" appears in claim 10 separate and apart from the step of removing the protective group. In view of the significant distinctions discussed above, reconsideration and withdrawal of the § 102 rejections of claims 10, 11, 14, and 20 is therefore respectfully requested.

Claims 19 and 20 were rejected under § 102 as being anticipated by *Keen*. With respect to claim 19, the Office Action characterizes *Keen* as disclosing a method wherein "[a] medium to be deposited is contacted with a substrate [and] an electric potential is applied to the substrate to deposit polymer strands." To the extent that this is the case, it is submitted that *Keen* therefore discloses nothing

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more than conventional electrochemical assembly of molecules, a process which has been well known to those of ordinary skill in the art even prior to the priority date of *Keen*.

It is further submitted that the present invention encompasses considerably more than mere electrochemical assembly of molecules, inasmuch as the present invention involves the selective inducing or retarding of molecular attachment to the substrate. In recognition of this aspect of the invention, claim 19 is amended herein to further specify that the molecular device molecules have, in addition to a metal-bonding group, "a protective group for impeding rapid attachment of said molecular device molecules to said metal substrate." It is submitted that this feature of the invention is neither taught nor suggested by the prior art, including *Keen*. It is further submitted that by including this further recitation into claim 19, that claim is fully and patentably distinguished from *Keen*.

With respect to claim 20, the Office Action states only that "[i]t is not apparent that the device recited in instant claim 20 differs from that disclosed by *Keen*." Applicant respectfully challenges this assertion, inasmuch as *Keen* neither teaches nor suggests a molecular circuit constructed by means of a process involving "impeding bonding of the molecular device molecules to the substrate sufficiently that application of a voltage potential to the substrate results in assembly of the molecular device on the substrate at a rate that is at least 1.5 times the rate of assembly of the molecular device on a voltage-neutral substrate." (Application, claim 20, page 28, lines 4-7).

Nowhere does *Keen* allude to a distinction between assembly on a charged substrate and that on a voltage-neutral substrate. Nowhere does *Keen* mention a mechanism or method for impeding bonding of a molecule with the substrate. To ascribe any of these features of the invention to *Keen* would amount to impermissible hindsight reconstruction of the instant invention. For all of these reasons, reconsideration and withdrawal of the § 102 rejection of claims 19-20 is respectfully requested.

Claims 20 and 21 were rejected under § 102 as being anticipated by *Reed*. According to the Office Action, "[t]he *Reed* patent is directed to sub-nanoscale

electronic systems and devices [including] conductive oligomers such as thiophene-ethylene oligomers ... functionalized with groups such as the thiol group and the carboxyl group." The Office Action further alleges that the functional groups in *Reed* "can be selectively attached to closely spaced metal pads."

Without challenging the Office Action's characterizations of *Reed*, Applicant notes merely that *Reed* clearly fails to teach or suggest other significant features of the invention disclosed and claimed in the instant application. Most importantly, it is noted that *Reed* wholly fails to teach or suggest electrochemical assembly of molecular systems. Thus, the requirement in the claims at issue that an electrical potential be applied to the substrate is not met by *Reed*. Moreover, nowhere does *Reed* either teach or suggest the concept of selectively impeding assembly of the molecular monolayer on the substrate, as is also required by the claims at issue. For these reasons, it is respectfully submitted that *Reed* falls far short of anticipating the invention disclosed and claimed in the instant application. Reconsideration and withdrawal of the § 102 rejection of claims 20 and 21 is therefore respectfully requested.

3. *The Section 103 Rejections.* Claims 1-4, 7-14, and 17 were rejected under § 103 as being unpatentable over *Keen* in view of *Kayyem*. The Office Action concedes, as is noted above, that *Keen* fails to teach or suggest the step of impeding bonding of the molecular device molecules to the substrate, but notes that *Kayyem* does disclose "the use of protective groups to protect the conductive oligomers." It is respectfully submitted that this is a mischaracterization of *Kayyem*.

First, it is again noted that *Kayyem* neither teaches nor suggests methods of electrochemical assembly of molecular device molecules on a substrate, or devices made using such techniques. With regard to the disclosure of "protecting groups," it is clear that *Kayyem* does not contemplate provision of protecting groups for "impeding bonding of the molecular device molecules to the substrate." On the contrary, *Kayyem* states that "it appears that protecting groups are required on the base, in order to prevent significant dimerization of conductive oligomers instead of coupling to the iodinated base." *Kayyem*, col. 68, lines 54-57. Indeed, *Kayyem* tends to teach away from the present invention, inasmuch as it suggests that the

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molecules must be subjected to an "in situ deprotection" to "remove[] the protecting group from the wire and allow[] it to bind to the gold." *Kayyem*, col. 64, lines 61-63. This teaching of *Kayyem* runs counter to the objective in the present application to utilize protecting groups on the molecules to impede assembly of molecules on a voltage-neutral substrate

Applicant further specifically challenges the Office Action's assertion that by making the proposed hypothetical combination of *Kayyem* and *Keen*, "the relative rates recited in claims 1-4 would have been expected to occur." In the first place, *Kayyem* neither teaches nor suggests electrochemical assembly of molecular device molecules in which a potential is applied to a substrate. *Keen*, on the other hand, fails to teach or suggest the use of protecting groups, and in any event provides no discussion of the relatively rates of assembly between a charged substrate and a voltage-neutral substrate. Thus, the proposed hypothetical combination of *Kayyem* and *Keen*, even if made, would not give persons of ordinary skill in the art any basis for comparison between assembly of protected and unprotected molecules or between assembly of molecules (either protected or unprotected) on a charged substrate versus that on a voltage-neutral substrate.

Claims 15 and 16 were rejected under § 103 as being unpatentable over *Keen* in view of *Kayyem*, and further in view of the "admitted prior art," the latter consisting of a discussion of protecting groups appearing in the Specification at page 5, lines 14-25. In this regard, it is to again be noted that *Kayyem* appears to contemplate the use of protecting groups to "prevent significant dimerization of conductive oligomers," whereas the protecting groups in the present application function to ensure that "the voltage applied to an electrode surface will cause the molecules to assemble on that surface significantly faster than on a non-charged surface in the same solution." (Specification, page 5, lines 10-12). This latter feature of the invention is not realized either in *Keen* (which does not discuss protecting groups) or in *Kayyem* (which calls for in-situ deprotection of the molecules prior to assembly).

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Claims 5, 6, and 18 were rejected under § 103 as being unpatentable over a proposed hypothetical combination of *Reed*, *Keen*, and *Kayyem*. According to the Office Action, "Reed discloses making electrical devices in which different oligomers are attached to two different closely spaced substrates." In this regard, it is noted that *Reed* appears to achieve assembly of different oligomers on closely spaced substrates through end-group functionalization of molecules to make them selectively adhere to pads of different compositions.

Notably, *Reed* does not teach or suggest impeding bonding of molecules so that application of a voltage potential to the substrate results in assembly of molecules on one substrate (a charged substrate) at a greater rate than that on another substrate (a voltage-neutral substrate). *Kayyem* is the only reference in the proposed combination which mentions protecting groups; however, *Kayyem* calls for "in-situ deprotection" of the molecules prior to assembly. Consequently, the proposed hypothetical *Kayyem/Keen/Reed* combination, even if made, would not achieve the benefits and functionality of the invention disclosed and claimed in the present application.

With specific reference to claim 6, Applicant notes that *Reed* neither teaches nor suggests electrically connecting molecular device molecules on one substrate with those on an adjacent substrate.

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CONCLUSION

In view of the foregoing, Applicant respectfully submits that each of the claims pending in the application is allowable, and that the application as a whole is in proper form and condition for allowance. If the Examiner believes that the application can be placed in even better condition for allowance, he is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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AMENDMENTS

Prior to further examination on the merits, please amend the application as follows:

19. (amended) A method for assembling a molecular circuit on a metal substrate, comprising:

- (a) providing a mixture comprising molecular device molecules in solution, each molecular device molecule having a metal-bonding group and a protective group for impeding rapid attachment of said molecular device molecules to said metal substrate;
- (b) contacting the metal substrate with the solution; and
- (c) applying a voltage potential to the substrate so as to attract the metal-bonding groups to bond to the substrate such that the molecular devices assemble on the substrate.